

THE HEALTH HAZARDS OF VOLCANIC ASH

A guide for the public

To order copies of this pamphlet,
visit the IVHHN website:
www.ivhhn.org



THE HEALTH HAZARDS OF VOLCANIC ASH

A guide for the public

This document has been prepared by the International Volcanic Health Hazard Network (IVHHN), Cities and Volcanoes Commission, GNS Science and the United States Geological Survey (USGS) to promote the safety of those who experience volcanic ashfall.

This guide explains the potential health effects of volcanic ash and gives details on how to protect yourself and your family in the event of a volcanic ashfall.



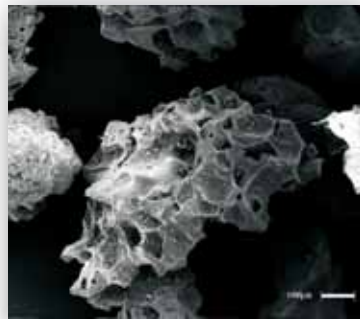
CONTENTS

1. What is volcanic ash?.....	Page 2
2. What are the effects of ash on health?	4
2.1 Respiratory effects	4
Why are people with chronic lung.....	5
problems at special risk?	
What factors affect respiratory symptoms?.....	6
2.2 Eye symptoms	7
2.3 Skin irritation	8
2.4 Indirect health effects of ashfall.....	8
3. What to do to protect yourself against ash.....	11
4. Precautions for children	14
5. Sources and further information	15

1. What is volcanic ash?

Volcanic ash is composed of fine particles of fragmented volcanic rock (less than 2 mm diameter). Volcanic ash is often hot very close to the volcano but is cool when it falls at greater distances. It is formed during volcanic explosions, from avalanches of hot rock that flow down the side of volcanoes, or from red-hot liquid lava spray. Ash varies in appearance depending upon the type of volcano and the form of the eruption. Thus, it can range in colour from light grey to black and can vary in size from being like grit to being as fine as talcum powder. Airborne ash blocks out sunlight, reducing visibility and sometimes causes complete darkness during day light.

Eruptions can also generate thunder and lightning from friction between the fine, airborne particles which can be localised above the volcano or accompany large ash plumes as they move downwind.



2 Large ash deposits can incorporate into existing soils and become the future topsoil of a volcanic region. The fertility of the soils around many volcanoes is due to old ash deposits. This beneficial effect of volcanism outweighs, over time, the hazards from infrequent eruptions, so fertile volcanic areas are often densely populated.

Freshly fallen ash particles can have acid coatings which may cause irritation to the lungs and eyes. This acid coating is rapidly removed by rain, which may then pollute local water supplies. Acidic ash can also damage vegetation, leading to crop failure.

In most eruptions, volcanic ash causes relatively few health problems, but generates much anxiety. People can be more fearful of the health hazards of volcanic ash and gases than of the risk of dying from more major hazards, such as pyroclastic flows. However, ashfalls can affect very wide areas around volcanoes and may cause major disruption to normal living.

Medical services can expect an increase in the number of patients with respiratory and eye symptoms during and after an ashfall event (see IVHHN guidelines on advice to the medical community).



3

2. What are the effects of ash on health?

Effects of ash on health may be divided into several categories: respiratory effects, eye symptoms, skin irritation and indirect effects.

2.1 Respiratory effects

In some eruptions, ash particles can be so fine that they are breathed deep into the lungs. With high exposure, even healthy individuals will experience chest discomfort with increased coughing and irritation. Common acute (short-term) symptoms include:

- ❖ Nasal irritation and discharge (runny nose).
- ❖ Throat irritation and sore throat, sometimes accompanied by dry coughing.
- ❖ People with pre-existing chest complaints may develop severe bronchitic symptoms which last some days beyond exposure to ash (for example, hacking cough, production of sputum, wheezing, or shortness of breath).
- ❖ Airway irritation for people with asthma or bronchitis; common complaints of people with asthma include shortness of breath, wheezing and coughing.
- ❖ Breathing becomes uncomfortable.

In rare circumstances, long-term exposure to fine volcanic ash may lead to serious lung diseases. For these diseases to occur, the ash must be very fine, contain crystalline silica (for the disease silicosis to occur) and the people must be exposed to the ash in high concentrations over many years. Exposure to crystalline

silica in volcanic ash is typically of short duration (days to weeks), and studies suggest that the recommended exposure limits (similar in most countries) can be exceeded for short periods of time for the general population.

People suffering from asthma or other lung problems such as bronchitis and emphysema, and severe heart problems are most at risk.

Why are people with chronic lung problems at special risk?

The fine ash particles irritate the airways and cause them to contract, making breathing more difficult in people who already have lung problems. The fine dust also causes the lining of the airways to produce more secretions which can cause people to cough and breathe more heavily. Asthma sufferers, especially children who may be heavily exposed to the ash when they play, may suffer bouts of coughing, tightness of the chest and wheezing. Some people who have never knowingly had asthma before, may experience asthma symptoms following an ashfall, especially if they go outdoors in the ash and over-exert themselves.



What factors affect respiratory symptoms?

The development of respiratory symptoms from the inhalation of volcanic ash depends on a number of factors. These include the concentration of particles in the air, the proportion of fine particles in the ash, the frequency and duration of exposure, the presence of crystalline silica and volcanic gases or aerosols mixed with the ash, and meteorological conditions. Existing health conditions and the use of respiratory protective equipment will also influence the symptoms experienced.



6

2.2 Eye symptoms

Eye irritation is a common health effect as pieces of grit can cause painful scratches in the front of the eye (corneal abrasions) and conjunctivitis. Contact lens wearers need to be especially aware of this problem and leave out their lenses to prevent corneal abrasion from occurring.

Common symptoms include:

- ❖ Eyes feeling as though there are foreign particles in them.
- ❖ Eyes becoming painful, itchy or bloodshot.
- ❖ Sticky discharge or tearing.
- ❖ Corneal abrasions or scratches.
- ❖ Acute conjunctivitis or the inflammation of the conjunctival sac that surrounds the eyeball due to the presence of ash, which leads to redness, burning of the eyes, and photosensitivity.



7

2.3 Skin Irritation

While not common, volcanic ash can cause skin irritation for some people, especially if the ash is acidic.

Symptoms include:

- ❖ Irritation and reddening of the skin.
- ❖ Secondary infections due to scratching.

2.4 Indirect health effects of ashfall

As well as the short and long term health risks, indirect impacts of large ashfalls on health must also be considered. These mainly arise from the secondary consequences of ashfall, for example:

- ❖ **Effects on roads**
The reduction in visibility from airborne ash alone may cause accidents. This danger is compounded by ash covering roads. Not only are road markings covered up, but thin layers of either wet or dry ash are very slippery, reducing traction. Thick deposits of ash may make roads impassable, cutting off communities from basic supplies.

- ❖ **Effects on power**

Ashfall can lead to power cuts. These may have implications for health due to lack of heating or other infrastructural requirements that depend on electricity. Wet ash is conductive, so it is essential that safe operating procedures are stringently followed when cleaning power supply equipment.



- ❖ **Effects on water supplies**

Ashfall can cause contamination of water or clogging and damage of water supply equipment. Small, open water supplies such as domestic water tanks with roof drainage are especially vulnerable to volcanic ashfall, and even small quantities of ash may cause problems for potability. While the risk of toxicity is low, the pH may be reduced or chlorination inhibited. During and after ashfalls, there is also likely to be extra water demand for clean-up, resulting in water shortages.

- ❖ **Effects on sanitation** (waste water disposal etc).
The temporary disablement of municipal sanitation systems may lead to increased disease in affected areas.

- ❖ **Risk of roof collapse**
1) Roofs can collapse from the weight of ash, resulting in injury or death for those underneath.



- 2) There is a danger of roof collapse whilst clearing ash from roofs due to the increased load of a person on an already overloaded roof.

- 3) In several eruptions people have died after falling from their roofs while cleaning up ash.

- ❖ **Animal health**
If the ash is coated in hydrofluoric acid, the ash can be very toxic to grazing animals if they ingest ash-covered grass and soil.



3. What to do to protect yourself against ash

- ❖ **Limit driving**
Immediately after an ashfall, even a light one, driving conditions, visibility and air quality can be dramatically affected, especially by the resuspension of ash by traffic. Rainfall has a sudden but temporary effect in improving air quality until the ash dries out again. We recommend that, following an ashfall, you refrain from driving and stay indoors if possible. If you must drive, maintain a large distance from the vehicle in front of you and drive slowly.
- ❖ **Reduce ash in your house**
Keep all doors and windows closed whenever possible.
- ❖ **Protection**
Those undertaking clean-up operations should always wear effective dust masks (see IVHHN Recommended Masks document at www.ivhhn.org). If no approved mask is available, a fabric mask improvised from cloth will filter out the larger ash particles which may contribute to throat and eye irritation. Dampening the fabric with water will improve its effectiveness. People with chronic bronchitis, emphysema or asthma are advised to stay inside and avoid unnecessary exposure to ash.
- ❖ **Eye protection**
In fine-ash environments, wear goggles or corrective eyeglasses instead of contact lenses to protect eyes from irritation.



❖ **Drinking water**

After light ashfall it is usually safe to drink water contaminated with ash, but it is better to filter off the ash particles before drinking. However, ash increases the chlorine requirement in disinfected surface-collected water which, therefore, can be microbiologically unsafe to drink. Ash will usually make drinking water unpalatable (sour, metallic or bitter-tasting) before it presents a health risk. The safest way to ensure your well-being is to stock up on water prior to the event. Collect enough drinking water for at least a week (up to one gallon , or 3-4 litres, per person per day). If you rely on collecting rainwater, cover the tank and disconnect any downpipes before ashfall occurs.

❖ **Home-grown food**

Ash-covered vegetables grown in fields are safe to eat after washing with clean water.

❖ **Clean-up**

Lightly water down the ash deposits before they are removed by shovelling, being careful not to excessively wet the deposits on roofs, causing excess loading and danger of collapse. Dry brushing can produce very high exposure levels and should be avoided. Hosing uses large quantities of water and may cause water shortages in heavily-populated areas.



4. Precautions for children

Children face the same hazards from the suspension of ash as other age groups, but their exposure may be increased because they are physically smaller and are less likely to adopt reasonable, prudent, preventive measures to avoid unnecessary exposure to ash. While evidence suggests that ingestion of small amounts of ash is not hazardous, we recommend that you take the following precautions:

- ❖ Keep children indoors if possible.
- ❖ Children should be advised against strenuous play or running when ash is in the air, since exertion leads to heavier breathing, drawing small particles more deeply into the lungs.
- ❖ Communities in heavy ashfall areas may wish to organize day-care programs to free parents for clean-up tasks.
- ❖ If children must be outdoors when ash is present in the air, they should wear a mask (preferably one approved by IVHHN). Many masks, however, are designed to fit adults rather than children.
- ❖ Take particular care to prevent children playing in areas where ash is deep on the ground or piled up.



5. Sources and further information

The International Volcanic Health Hazard Network (IVHHN) was founded in 2003, and is a group of experts who have a common aim of understanding and addressing the health effects of volcanic emissions. Expert members work in a range of disciplines such as volcanology, public health and toxicology. For further information, visit the IVHHN website (www.ivhhn.org). Many resources, such as a guide to recommended dust masks, are available on the website.

The United States Geological Survey (USGS) website provides information on effects of ash on health from historical eruptions, and further information on potential chronic diseases caused by crystalline silica and volcanic ash (<http://volcanoes.usgs.gov/ash/health/index.html>).

This guide is based on the following sources

Residents' guide to the state of the Soufriere Hills volcano following the scientific assessment of July 1998 and the dangers of volcanic ash, with tips for cleaning up ash. Emergency Department, St Johns, Montserrat, West Indies, August 1998.

Volcanic ashfall: how to be prepared for an ashfall. USGS Cascades Volcano Observatory, Vancouver, Washington, November 1999.

Ash particles and home clean-up problems: advice from the University of Idaho. Mt. St. Helens Technical Information Network Bulletin 7, Federal Coordinating Network, May 1980.

Health criteria for reoccupation of ashfall areas in Montserrat. Report to the Department for International Development, London, by P.J. Baxter and R.L. Maynard, October 1998.

The mitigation of ashfall damage to public facilities: lessons learned from the 1980 eruption of Mt. St. Helens. Washington Federal Emergency Management Agency, Region X, by W. H. Mayer, Regional Director, 1984.

Volcanic hazards: a sourcebook on the effects of eruptions. By R.J. Blong, Academic Press, Sydney, 1984.

Mt. St. Helens Technical Information Network Bulletin 14, 1980.

Preventive health measures in volcanic eruptions. By P.J. Baxter, American Journal of Public Health 76, pp 84-90, 1986.



Notes

Acknowledgements

This document was written by a panel of IVHHN expert members chaired by Dr Claire Horwell and Dr Peter Baxter of the University of Cambridge, UK, with assistance from staff of the United States Geological Survey. The IVHHN is grateful to the Leverhulme Trust, UK, for funding associated meetings, and to the following people for reviewing this guideline document:

- Dr Bob Maynard, Department of Health, London, UK;
- Steve Brantley, USGS Hawaiian Volcano Observatory, Hawai'i, USA;
- Dr Phil Weinstein, School of Population Health, University of Western Australia, Perth, Australia;
- Dr David Johnston, GNS Science, Lower Hutt, New Zealand;
- Scott Barnard, University of Canterbury, Christchurch, New Zealand;
- Dr Carol Stewart, Wellington, New Zealand.

All photos are copyright to GNS Science, except for the following which have been used with the permission of their owners: page 3 (Gisborne Herald), page 9 (Transpower New Zealand), page 10 lower photo (New Zealand Herald) and page 13 (Scott Barnard, University of Canterbury).